SAN BERNARDINO MICROWAVE SOCIETY, Incorporated

FOUNDED IN 1955

A NON-PROFIT AMATEUR TECHNICAL ORGANIZATION DEDICATED
TO THE ADVANCEMENT OF COMMUNICATIONS ABOVE 1000 MC.

W6IFE Newsletter

October 2009 Edition

At the **1 October 2009** SBMS meeting the "Tech Talk" will be Mismatch Errors in Noise Figure measurement by Dick Kolbly; K6HIJ.The SBMS meets at the American Legion Hall 1024 Main Street (south of the 91 freeway) in Corona, CA at 1900 hours local time on the first Thursday of each month. Check out the SBMS web site at http://www.ham-radio.com/sbms/.

REMINDER- NO PARKING IN THE CHURCH LOT

Last meeting. Welcome to new members Tom Board, WB6HYHof Rancho Cucamonga; Ben Wallace, KD0EJT of Long Beach. 26 people present. Gary, W6KVC and Don, KE6BXT lead the talk on ATV operations by having numerous amateurs check in on the METS and ATN networks including via internet several operators in Argentina and Italy- LU7DTS, LU5DNP, LU1VDA, an LU6 station. Later several stations gave a tour of their stations via their own video cameras, K6BNN, KA6DRS, AC6RB, and W6KGE. Gary gave information on his station at the meeting with switchers, multi-cameras, 2 GHz transmitter and 3 GHz receiver and 1.2 GHz receiver. Don had a number of antennas to show. He also gave a presentation on how ATV is used to cover parades, field Day and ARES/RACES operations. There was to be a live presentation of the ATV equipment at Mt. Wilson, but the "Station Fire" had the mountain evacuated. Visitors were Wayne N6QCU from Fontana; Earl, W6LF of Baldwin Park. Walt gave a demo of circular polarization using his 10 GHz transmitter and LED receiver. 28 people were present

Scheduling.
23-25 Oct Microwave Update 2009 Dallas TX
5 November- Rein W6SZ on using WSPR digital mode on microwaves

3 December- 1296 MHz rig designs
7 January- Agilent on New equipment
4 February- Open- Suggestions?
MUD 2010 Wednesday October 20 ----- Sunday October 24 Los Angeles area. SBMS is sponsoring it.

Activity and Contest plans reported at the September SBMS meeting: Doug, K6JEY will be on Signal Hill with generator; Jerry, N7EME fixed his rig and will be on Heaps or Signal Pks; Jeff, KN6VR operated at Quartzite; Dave WA6CGR did Kettelman City and south; Dick, K6HIJ worked on 10ghz equipment and made a run of 24 GHz waveguide switches; Mel, WA6JBD had a last minute radio to fix; Tom, WB6HYH has a 2.4 GHz ATV transmitter; Chris, N9RIN had rig problems; Don, KE6BXT gave an ATV talk to the Santa Barbara club; Gary, W6KVC did some set up for the ATV talk; Dave, N6TEB had a group roving with him; Kent, K6WCI had a roving group; Dick WB6JDH went roving; Rein, W6SZ was out with Doug and the generator, and did some WSJT work on air with K6HLH; Ed, W6OYJ roved with the San Diego group and had 3 QSOs with Arizona hams; Bill, WA6QYR was on Frazier and had lots of contacts; Chuck, WA6EXV reported some of the big dishes are gone from the OVRO site, but not the 40 meter that SBMS projects work on; Dick, WB6DNX operated from Chino Hills;

Wants and Gots for sale.
For Sale- Gonset 20mtr 5 elm beam $20; Hustler 5 band 80-40-20-15-10m vertical $30; 20mtr vertical $20; 70 ft 4 section Trasto crank up tower $500; 2 220MHz heavy duty 7 el beams $15 each; 6 ft spin aluminum dish (no back mounting support) $50; 4 ft dish $30; Hallicrafter HT32A transmitter with manual $100, Scott Navy WW2 18 KHz-20 MHz receiver Bill WA6QYR 760-375-8566 bburns@ridgenet.net.

Want- 4 ft prime focus dish mesh preferred or 39 inch offset feed dish Ed WX6DX 714-993-8895 eamurashie@beckman.com

Threads .
I started writing this email last night on the way home in the cab of a tow truck, but my cell phone decided to crash...
My usual 10 GHz contest operation is on Signal Hill in Long Beach and I've had some success there, but it was starting to get old. Over the years I have done several good trips, some roving, etc. This year I decided to return to Frazier which provided a lot of learning.
First lesson:
Do not drive a 40 year old highly modified (lowered, stiffer suspension, motor swap, near-race tires) sports car up dirt roads. They don't like it. Even the mild dirt road that is Frazier Mountain Road... Actually the car did _okay_, it was the headlights that went south on me. One of the modifications to this car was an "upgrade" to H4 bulbs. Turns out they don't seal too well and water gets in and when driving on uneven surfaces at night, the water splashes up onto the hot bulb and it explodes.
The first one went out on the way up Friday night, and I thought nothing of it. Saturday evening after getting back to the campsite I decided that another ascent on Sunday would be too much for the car, and I might start donating nuts, bolts and so on to the Los Padres National Forest.
It was at this point I decided to drive home, and stop to get a new bulb as soon as I could. About the time I reached the ranger station I realized that in my hurried packing, I had forgotten my trusty old (first ham radio I owned) Yaesu FT-470 HT back at the campsite. I turned around and started heading up the road and the last remaining headlight decided to explode. So here I am, in the middle of nowhere, PITCH black, no cell phone service, etc. So I pulled out some duct tape and a couple $2.99 Harbor Freight LED flashlights and soon I was on my way back to civilization. It was far too dangerous to drive that way to go get the radio, so there it will sit. I left a message with the ranger, so if someone does bring it back they know who to call.
Anyway, I made it back to Frazier Park Rd. and Lockwood Valley Road and waited for my flatbed. I made it home and today I replaced the bulbs and sealed up the gaps with high temp RTV Silicone. We'll see how that works out...
Second Lesson:
LO phase noise sucks! There were a bunch of contacts I simply did not make on 10 GHz only because I had such poor phase noise that the beacon bled through everywhere. This is not a problem on Signal Hill...
My 10 GHz radio is an early first generation Qualcomm rig I built back in 1996. It is overdue for some

updates or maybe replacement. I'm thinking after I finish some other projects, I'll build an all bare-MMIC transverter with the RF section in something the size of an Altoids tin possibly with a DRO or YIG LO.
Third Lesson:
24 GHz is FUN! And WEIRD! This is not my first contest with my current
24 GHz rig, but I made my best DX of 189 km to Steve W6QIW and Lars AA6IW.
Frank did a little better than I did though I think the antenna had a lot to do with that (1.2 meter versus 1 foot). My 24 GHz radio is definitely a higher performance radio than my 10 GHz radio, and I felt like I could almost hear a difference. Not sure what, but signals on 24 just sound really nice. Maybe it is just the excitement! Can't wait to operate more
24 GHz in the cold months. There are enough people out there on 24 finally to make it worthwhile. Can't wait to learn more about the very different propagation characteristics of 24 GHz.
Fourth Lesson:
Working in a group on Frazier is much harder than on Signal Hill.
Proximity makes a huge difference. Frank did a great job of organizing all of us, and probably sacrificed some points so that the rest of us could work everyone. Thanks Frank!
Pictures from this weekend:http://www.flickr.com/photos/kc6qhp/sets/72157622297930233/
HD video of the site, and 10 GHz operations:http://www.youtube.com/watch?v=6MeL4vPiEZg
Finally, thanks to Robin and the Cactus system for the excellent liaison system.
Tony KC6QHP

Tony, at the Oct meeting of the 50MHz and Up Group I will be talking about both my updated SDR circuits and also about microwave transceiver problems and suggested fixes.
The phase noise you have in your qualcomm circuits is not the only reason for getting jammed by the beacon. For example, I have a Kuhne DB6NT LNA ahead of my DB6NT transverter. Last week I measured the compression on my bench for the first time. I was dismayed to find it was -50dBm. I had not looked at the schematics of both DB6NT units previously. There are three stages of GaAs devices in each of the two. I added a serious multistage waveguide filter and a 10dB attenuator between the two units and that only improved the compression by 3dB.
So clearly the LNA is the culprit. Since that was already Friday afternoon, I had to leave it that way and stay far away from the beacon on Vaca. I know that in my case I have excellent phase noise as I am locking a crystal oscillator with a PLL that I designed with a loop bandwidth of 100Hz. The phase noise is really the crystal oscillator above a few hundred Hz. Within the loop, my 10MHz reference is very low noise and has a floor of -162dBc/Hz and is better than -150 @ 1 KHz offset.
I recommend this over using a YIG or a VCO, unless you use a very wideband locking technique such as a switching diode, not a PLL chip, and then use a super low phase noise reference at 100MHz.
I also recommend staying away from broadband mmics as they will contribute a lot of noise and their bandwidth will contribute many undesired responses.
And similar to Mel's report, my antenna performance is poor compared to others' dishes next to me. I will replace it soon with an offset dish and an optimized feed.73, Jeffrey Pawlan WA6KBL

Hi All,
As I was trying to get something going during this contest weekend I like to report on the zero results.
Things started to go bad on Friday when I found out that my IF radio would not work any longer. This, effectively preventing me from transmitting. Doug K6JEY would have been able to transmit digital though.
On Saturday we were QRV form about 1:30 or so. I got the receive setup going but had to rearrange to get the computer screen light shielded as I could not read the laptop screen due to bright Sun etc..(Big Problem)
With 2 active operating stations at the lower end of the band next door, I had tons of overload/intermod problems.
We were there perhaps for 2 to 3 hours and then packed up.
Sunday I was receiving all day at home and Larry K6HlH was providing JT65C signals virtually all day until around 20:00 or so.
The idea was to find a path on 10 GHz to do tests and experiments (we are both retired and have time to play) that day at least I never saw anything from Larry. That's all I can say about it. We have a very efficient path on 1296 MHz.

I like to thank Larry here one more time, for spending all the time and his efforts with me. REAL AMATEUR SPIRIT Though I saw the beacon reflections off the mountains, traces running over the screen, plane reflections etc something strange happened around 8 0'clock lasting for perhaps at least 15 minutes.
A fast upwards (in freq) moving carrier appeared First the carrier was moving upwards perhaps 15 seconds stopped for perhaps 5 seconds and came back, repeating the same pattern (like sending a series of "a"/s (or "n"'s if you want, with the radio heating up Then some time later it would do a similar pattern but the "dots" where on a shifted lower frequency, both signals still drifting upwards.
This and combinations of this went on for some time.
Then I noticed the carrier, less drifting and switching from a single signal to four signals shifted in equal frequencies. The xyl was getting in play and I must have been too tired but got to think later that the 4 signal deal might have been JT4F or G Unfortunately I did not spent more time on this.
Tried to get in contact via the JT65 Logger but no responses there
Question: Was somebody in the 300 - 330 segment testing, or trying to get on, or what have you, around that time Sunday evening?
If so, I would really like to learn about it.
If others have tried yesterday to contact me with digital mode(s) I am sorry that I could not do more.
73 Rein W6SZ

The Effects of Mismatch on Noise Measurements
Dick Kolbly, K6HIJ

Summary: This paper discusses the effects that mismatched source/load interfaces have on the accuracy of noise temperature/noise figure measurements. Calculation of the range of error caused by impedance mismatch is shown.

Introduction: Most of us are aware that a mismatch (or Voltage Standing Wave Ratio) can cause a loss of power transmitted to a load. These mismatches will cause errors in measurements of power. Since measurement of noise temperature or noise figure is done by measuring power ratios, we should understand our measurements.

A recent book [1] discusses in great detail the subject of noise temperature. Although much of the material in this book is available elsewhere [2], [3], Mr. Otoshi has collected a tremendous amount of theoretical and practical information into one document, including an excellent discussion of mismatch error. Most of the material in this paper was derived from this book. I wish to express my appreciation to Mr. Otoshi and Dr. Stelzried for their excellent work and to the publisher for making this book readily available.

The radio amateurs that experiment in the UHF and microwave bands (300 MHz and up) are well aware of the importance of noise figure on weak signal reception. Traditionally, we assume that all of the devices in our test set are well-matched. Often, this is not the case. A preamplifier tuned for best noise figure will not, in general, be set up for best power transfer. Antennas generally are not perfectly matched. The question we may ask is: How big of an error can we expect with the equipment we are using? In low noise systems, the temptation is to carefully tune each of the interfaces to match a common impedance, typically 50 ohms for coaxial systems or the normalized waveguide impedance. This temptation must be tempered against the noise added by the losses of additional hardware in the signal path.

A Review of Noise Fundamentals: Amateurs are used to expressing the noise performance of a device in terms of noise figure. The noise figure is the noise factor, expressed in decibels. A more fundamental expression of noise performance is noise temperature, which is the temperature of a matched load putting out the same amount of power as measured at a point in the system. Noise performance values are traditionally referenced to the input of the device being characterized.

A fundamental constant in noise measurements is Boltzmann's Constant (k), a value for the noise power output of a resistor:

$$\mathbf{k = 1.3806503 \times 10^{-23}\ Joules\ K^{-1};}$$

or in units we are more familiar with:

k = 1.3806503 x 10-23 Watts/Hz/K or: -198 dBm/Hz/K

where:

K is the temperature of the resistor in kelvin (K = C-273)

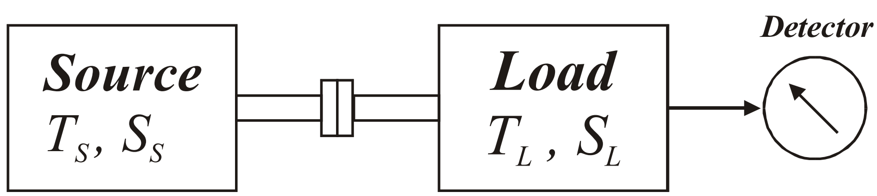
Conversion between Noise Figure, Noise Factor, and Noise Temperature, can be done with the following formulas:

$$NoiseFigure = 10\log(NoiseFactor) \qquad NoiseFactor = 10^{\frac{NoiseFigure}{10}}$$

$$NoiseFigure = 10\log(\frac{(NoiseTemp)}{290}+1) \qquad NoiseTemp = 290(NoiseFactor - 1)$$

Table 1 in the Appendix is provided to convert between these units.

Noise Measurements disregarding Mismatch: Figure 1 is a simplified diagram of a receiving system. The source can be a load, antenna, or a signal source. All of these can be regarded as a noise source. For purposes of this discussion, we will treat the source as a noise source. The load is our normal receiver, with some form of power measurement on the output. It is important that the receiver be linear.



T_S , T_L : Noise Temperature in K

S_L , S_L : Voltage Standing Wave Ratio

Figure 1

Noise measurements can be made by changing the source temperature and measuring the change in output of the load (typically a receiver system). This change is expressed in decibels and called the Y-factor.

If we disregard any errors due to mismatch, the ratio at the detector is:

$$Y(Ratio) = \frac{T_{s1}+T_l}{T_{s2}+T_l} \quad ;$$

Where T_{S1} and T_{S2} are the two temperatures of the source. This is the classic noise measurement technique.

The Effect of Mismatch on Noise Measurements: The question is: How much does a mismatch between the source and load effect our measurement? If a generator and a load are not matched in impedance, not all power available from the generator will be transferred to the load. For a simple discussion of mismatch loss, we will need to define some terms:

P_a: The power that will be transferred into a matched load. (Available Power)

P_e: The power that is actually transferred into a mismatched load. (Effective Power)
Mismatch Factor (M): Effective Power divided by Available Power

At this point, we have only discussed the actual impedance indirectly, in mentioning the VSWR of the source and load. Since we, in general, do not know the actual impedance (a complex number with a resistive and reactive component) of either the source or load, there will be a minimum and a maximum mismatch factor. Any load or source can be matched by providing an impedance that is the complex conjugate (i.e. if the source is R+jX, then the match is R-jX).

The maximum and minimum Mismatch Factors can be calculated from the following:

First, we convert VSWR to Reflection Coefficient:

$\Gamma_s = \frac{\sigma_s - 1}{\sigma_s + 1}$ and $\Gamma_l = \frac{\sigma_l - 1}{\sigma_l + 1}$; Γ is the Reflection Coefficient and σ is VSWR.
The subscripts s and l refer to source and load respectively.

Then the maximum and minimum mismatch factors are calculated:

$$M_{Max} = \frac{\left(1-\Gamma_s^2\right)\left(1-\Gamma_l^2\right)}{\left(1-\Gamma_s\Gamma_l\right)^2} \qquad M_{Min} = \frac{\left(1-\Gamma_s^2\right)\left(1-\Gamma_l^2\right)}{\left(1+\Gamma_s\Gamma_l\right)^2}$$

The Mmin and Mmax values can also be calculated directly from the VSWR values:

$$M_{Max} = \frac{4 * \sigma_s \sigma_l}{\left(\sigma_s + \sigma_l\right)^2} \qquad M_{Min} = \frac{4 * \sigma_s \sigma_l}{\left(\sigma_s \sigma_l + 1\right)^2}$$

Table II in the Appendix are calculated values of Mmin and Mmax for Source and Load mismatches in both VSWR and Reflection Coefficient. Note that the results are the same if the VSWR of the source and load are interchanged.

Once the minimum and maximum mismatch factors are known, we can calculate the best and worst case for power transfer:

For best Power Transfer with given VSWR or Voltage Reflection Coefficients:

$$P_d = P_g M_{Max}$$

where P_d is power delivered to the load, and P_g is the maximum power available from the generator.

Similarly, for worst-case power transfer,

$$P_d = P_g M_{Min}$$

We can substitute Effective Temperature for power in the above equations to determine delivered noise temperature from a noise source.

Now we have enough information to calculate the effects of mismatch on noise temperature measurements. However, we must heed Mr. Otoshi's warning [Ref 1, p. 199]: "As will be seen, the mismatch equations are complex and cumbersome."

If we ignore the phase angles of the mismatch, we can only determine the upper and lower bounds for mismatch errors. For the purposes of discussion, we will discuss Y Factor measurements between an ambient load and the antenna. Of course, this analysis would be valid in measuring using any hot-cold load combination. Examination of the measurement techniques will reveal that there are four possible mismatch error limit conditions:

1. Ambient Load and Antenna have minimum loss factors.
2. Ambient Load and Antenna have maximum loss factors.
3. Ambient Load has minimum loss factor, Antenna has maximum loss factor.
4. Ambient Load has maximum loss factor, Antenna has minimum loss factor.

By using these loss factors, we can determine the error bounds of any measurements. Figure 2 is a block diagram of a typical receiving system with the values annotated.

Using the mismatch factors obtained from Table II, we can determine the maximum and minimum noise from each source.

Let us demonstrate by example. Using the following values, we will calculate the antenna noise temperature and the possible error values:

VSWR of antenna:	1.67	Physical Temperature of Load:	290 K
VSWR of Receiver:	1.50	Noise Temperature of Receiver:	120 K
VSWR of Load:	1.11	Measured Y-Factor:	2.34 dB

These are typical values for a representative high-quality 10.368 GHz receiving system. We will now calculate the antenna temperature and error limits.

First, we convert our Y-Factor (measured in dB) to a power ratio:

$$Y(Ratio) = 10^{\frac{Y(dB)}{10}} = 10^{\frac{2.34}{10}} = 1.714$$

Assuming no mismatch losses, the antenna temperature is:

$$T_a(Matched) = \frac{T_l + T_r - T_r Y_r}{Y} = \frac{290 + 120 - 205.7}{1.714} = 119.2K$$ **or NF = 1.50 dB**

T_A, T_L, T_R: Noise Temperature in K

S_A, S_L, S_R: Voltage Standing Wave Ratio

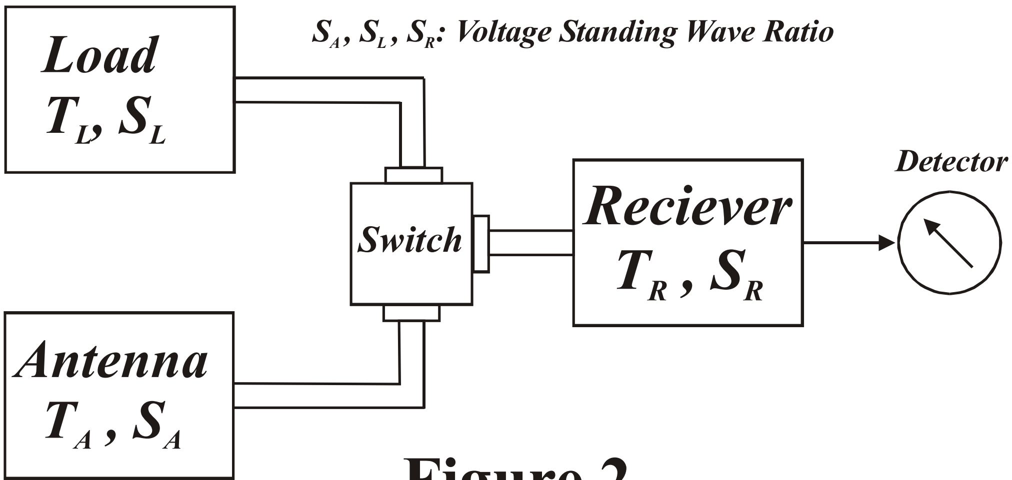


Figure 2

From Table II, we determine the mismatch loss factors:

Next, we determine the mismatch factors (from Table II):

	Maximum	Minimum
Antenna-Receiver	0.997	0.816
Load-Receiver	0.977	0.939

$T_l(Min) = 0.939 * 290 = 272.3K$ and $T_l(Max) = 0.977 * 290 = 283.5K$

This corresponds to an error of about 15° K or about 0.22 dB due to mismatch between the receiver and load. Using these maximum and minimum values of noise temperature *delivered* from the ambient load, we calculate the effective noise temperature of the antenna:

$$T_a(Min) = \frac{T_{l(Min)} + T_r - YT_r}{Y} = \frac{272.3 + 120 - 205.7}{1.714} = 108.9K;$$

$$T_a(Max) = \frac{T_{l(Max)} + T_r - YT_r}{Y} = \frac{283.5 + 120 - 205.7}{1.714} = 115.4K$$

Now we apply the maximum and minimum antenna-receiver mismatch factors to each of these calculated antenna temperatures, giving a set of four antenna temperatures:

Case 1: $T_a(1) = \frac{T_a(Max)}{M_{Max}(AntRx)} = \frac{115.46}{0.997} = 115.81K$ **(NF=1.46 dB, Error = -0.04 dB)**

Case 2: $T_a(2) = \frac{T_a(Max)}{M_{Min}(AntRx)} = \frac{115.46}{0.816} = 115.49K$ **(NF=1.75 dB, Error = +0.25 dB)**

Case 3: $T_a(3) = \dfrac{T_a(Min)}{M_{Max}(AntRx)} = \dfrac{108.9}{0.997} = 109.2K$ **(NF=1.39 dB, Error = -0.11 dB)**

Case 4: $T_a(4) = \dfrac{T_a(Min)}{M_{Min}(AntRx)} = \dfrac{108.9}{0.816} = 133.5K$ **(NF=1.65 dB, Error = +0.15 dB)**

This same analysis technique can be used to determine the error limits of any other noise temperature measurement.

There is one error source that we have not discussed. Any amplifier will act as a noise source at its input port. If the input is matched, this noise will be radiated or dissipated harmlessly. If the receiver is not matched to the antenna, this noise will be reflected back into receiver input, increasing the system temperature. In general, the value of this source of noise is not known. To further complicate the issue, this reflected noise is correlated with the noise generated in the amplifier by some factor. As a rough approximation, we can guess that this noise source is about the same as the noise temperature of the amplifier. In the example given, this would result in a contribution of less than 1°K. In the analysis presented in this paper, we have ignored this contribution. For further discussion on this, see Otoshi pp. 199-200 [Ref. 1].

References:

[1] Otoshi, Tom Y., “Noise Temperature Theory and Applications for Deep Space Communications Antenna Systems”, Boston, Artech House, 2008

[2] Agilent Application Note 57-1, “Fundamentals of RF and Microwave Noise Figure Measurements”, 2000

[3] Agilent Application Note 57-2, “Noise Figure Measurement Accuracy – The Y-Factor Method”, 2001

[4] Agilent Application Note 64-1C, “Fundamentals of RF and Microwave Power Measurements”, 2001

Table I - Noise Conversion

Noise Figure	Noise Factor	Temp (K)	Noise Figure	Noise Factor	Temp (K)	Noise Figure	Noise Factor	Temp (K)
0.00	1.0000	0.00	5.00	3.16	627.06	10.00	10.00	2610.00
0.10	1.0233	6.75	5.10	3.24	648.42	10.10	10.23	2677.55
0.20	1.0471	13.67	5.20	3.31	670.28	10.20	10.47	2746.67
0.30	1.0715	20.74	5.30	3.39	692.65	10.30	10.72	2817.41
0.40	1.0965	27.98	5.40	3.47	715.54	10.40	10.96	2889.79
0.50	1.1220	35.39	5.50	3.55	738.96	10.50	11.22	2963.85
0.60	1.1482	42.96	5.60	3.63	762.93	10.60	11.48	3039.65
0.70	1.1749	50.72	5.70	3.72	787.45	10.70	11.75	3117.20
0.80	1.2023	58.66	5.80	3.80	812.55	10.80	12.02	3196.57
0.90	1.2303	66.78	5.90	3.89	838.23	10.90	12.30	3277.78
1.00	1.2589	75.09	6.00	3.98	864.51	11.00	12.59	3360.88
1.10	1.2882	83.59	6.10	4.07	891.40	11.10	12.88	3445.92
1.20	1.3183	92.29	6.20	4.17	918.92	11.20	13.18	3532.94
1.30	1.3490	101.20	6.30	4.27	947.08	11.30	13.49	3621.99
1.40	1.3804	110.31	6.40	4.37	975.90	11.40	13.80	3713.11
1.50	1.4125	119.64	6.50	4.47	1005.38	11.50	14.13	3806.36
1.60	1.4454	129.18	6.60	4.57	1035.56	11.60	14.45	3901.78
1.70	1.4791	138.94	6.70	4.68	1066.43	11.70	14.79	3999.41
1.80	1.5136	148.93	6.80	4.79	1098.03	11.80	15.14	4099.33
1.90	1.5488	159.16	6.90	4.90	1130.36	11.90	15.49	4201.57
2.00	1.5849	169.62	7.00	5.01	1163.44	12.00	15.85	4306.19
2.10	1.6218	180.32	7.10	5.13	1197.30	12.10	16.22	4413.25
2.20	1.6596	191.28	7.20	5.25	1231.94	12.20	16.60	4522.80
2.30	1.6982	202.49	7.30	5.37	1267.39	12.30	16.98	4634.91
2.40	1.7378	213.96	7.40	5.50	1303.67	12.40	17.38	4749.62
2.50	1.7783	225.70	7.50	5.62	1340.79	12.50	17.78	4867.01
2.60	1.8197	237.71	7.60	5.75	1378.78	12.60	18.20	4987.13
2.70	1.8621	250.01	7.70	5.89	1417.65	12.70	18.62	5110.05
2.80	1.9055	262.58	7.80	6.03	1457.42	12.80	19.05	5235.84
2.90	1.9498	275.45	7.90	6.17	1498.13	12.90	19.50	5364.55
3.00	1.9953	288.63	8.00	6.31	1539.78	13.00	19.95	5496.26
3.10	2.0417	302.10	8.10	6.46	1582.40	13.10	20.42	5631.04
3.20	2.0893	315.90	8.20	6.61	1626.01	13.20	20.89	5768.96
3.30	2.1380	330.01	8.30	6.76	1670.64	13.30	21.38	5910.09
3.40	2.1878	344.45	8.40	6.92	1716.31	13.40	21.88	6054.51
3.50	2.2387	359.23	8.50	7.08	1763.04	13.50	22.39	6202.29

Table I - Continued - Noise Conversion

Noise Figure	Noise Factor	Temp (K)	Noise Figure	Noise Factor	Temp (K)	Noise Figure	Noise Factor	Temp (K)
3.60	2.2909	374.35	8.60	7.24	1810.86	13.60	22.91	6353.52
3.70	2.3442	389.83	8.70	7.41	1859.80	13.70	23.44	6508.26
3.80	2.3988	405.66	8.80	7.59	1909.87	13.80	23.99	6666.62
3.90	2.4547	421.87	8.90	7.76	1961.12	13.90	24.55	6828.66
4.00	2.5119	438.45	9.00	7.94	2013.55	14.00	25.12	6994.47
4.10	2.5704	455.41	9.10	8.13	2067.21	14.10	25.70	7164.15
4.20	2.6303	472.78	9.20	8.32	2122.11	14.20	26.30	7337.78
4.30	2.6915	490.55	9.30	8.51	2178.30	14.30	26.92	7515.45
4.40	2.7542	508.73	9.40	8.71	2235.79	14.40	27.54	7697.26
4.50	2.8184	527.33	9.50	8.91	2294.63	14.50	28.18	7883.31
4.60	2.8840	546.37	9.60	9.12	2354.83	14.60	28.84	8073.69
4.70	2.9512	565.85	9.70	9.33	2416.44	14.70	29.51	8268.51
4.80	3.0200	585.79	9.80	9.55	2479.48	14.80	30.20	8467.86
4.90	3.0903	606.19	9.90	9.77	2543.99	14.90	30.90	8671.86

Table II - Minimum and Maximum Mismatch Factor

		Load Gamma	0.00	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95
		Load VSWR	1.00	1.11	1.22	1.35	1.50	1.67	1.86	2.08	2.33	2.64	3.00	3.44	4.00	4.71	5.67	7.00	9.00	12.33	19.00	39.00
Source Gamma	Source VSWR																					
0.00	1.00	Max	1.000	0.997	0.990	0.977	0.960	0.937	0.910	0.877	0.840	0.797	0.750	0.697	0.640	0.577	0.510	0.437	0.360	0.277	0.190	0.097
0.00	1.00	Min	1.000	0.997	0.990	0.977	0.960	0.937	0.910	0.877	0.840	0.797	0.750	0.697	0.640	0.577	0.510	0.437	0.360	0.277	0.190	0.097
0.05	1.11	Max	0.997	1.000	0.997	0.990	0.977	0.959	0.936	0.907	0.872	0.833	0.787	0.736	0.678	0.615	0.546	0.471	0.390	0.302	0.208	0.107
0.05	1.11	Min	0.997	0.990	0.978	0.961	0.939	0.912	0.881	0.845	0.805	0.761	0.712	0.659	0.602	0.540	0.475	0.405	0.332	0.255	0.174	0.089
0.10	1.22	Max	0.990	0.997	1.000	0.997	0.990	0.976	0.957	0.933	0.902	0.866	0.823	0.773	0.717	0.654	0.584	0.506	0.421	0.328	0.227	0.118
0.10	1.22	Min	0.990	0.978	0.961	0.939	0.913	0.883	0.849	0.811	0.769	0.723	0.673	0.620	0.564	0.504	0.441	0.375	0.306	0.233	0.158	0.081
0.15	1.35	Max	0.977	0.990	0.997	1.000	0.997	0.989	0.975	0.955	0.929	0.896	0.857	0.810	0.755	0.693	0.622	0.543	0.454	0.356	0.248	0.130
0.15	1.35	Min	0.977	0.961	0.939	0.914	0.885	0.851	0.815	0.774	0.731	0.684	0.634	0.582	0.527	0.469	0.408	0.346	0.281	0.213	0.144	0.073
0.20	1.50	Max	0.960	0.977	0.990	0.997	1.000	0.997	0.989	0.974	0.953	0.925	0.889	0.845	0.793	0.732	0.662	0.581	0.490	0.387	0.271	0.143
0.20	1.50	Min	0.960	0.939	0.913	0.885	0.852	0.816	0.778	0.736	0.691	0.644	0.595	0.543	0.490	0.434	0.377	0.318	0.257	0.195	0.131	0.066
0.25	1.67	Max	0.937	0.959	0.976	0.989	0.997	1.000	0.997	0.988	0.972	0.949	0.918	0.879	0.830	0.772	0.702	0.621	0.527	0.420	0.297	0.157
0.25	1.67	Min	0.937	0.912	0.883	0.851	0.816	0.779	0.738	0.696	0.651	0.604	0.556	0.505	0.454	0.401	0.346	0.291	0.234	0.177	0.119	0.060
0.30	1.86	Max	0.910	0.936	0.957	0.975	0.989	0.997	1.000	0.997	0.987	0.970	0.945	0.910	0.866	0.811	0.744	0.663	0.567	0.455	0.324	0.174
0.30	1.86	Min	0.910	0.881	0.849	0.815	0.778	0.738	0.697	0.654	0.609	0.563	0.516	0.468	0.418	0.368	0.317	0.265	0.213	0.160	0.107	0.054
0.35	2.08	Max	0.877	0.907	0.933	0.955	0.974	0.988	0.997	1.000	0.997	0.986	0.967	0.939	0.900	0.849	0.785	0.706	0.609	0.493	0.355	0.192
0.35	2.08	Min	0.877	0.845	0.811	0.774	0.736	0.696	0.654	0.611	0.567	0.522	0.477	0.430	0.384	0.336	0.289	0.241	0.193	0.145	0.096	0.048
0.40	2.33	Max	0.840	0.872	0.902	0.929	0.953	0.972	0.987	0.997	1.000	0.996	0.984	0.963	0.931	0.886	0.826	0.750	0.654	0.535	0.390	0.213
0.40	2.33	Min	0.840	0.805	0.769	0.731	0.691	0.651	0.609	0.567	0.524	0.481	0.437	0.394	0.350	0.306	0.261	0.217	0.174	0.130	0.086	0.043
0.45	2.64	Max	0.797	0.833	0.866	0.896	0.925	0.949	0.970	0.986	0.996	1.000	0.996	0.982	0.958	0.920	0.867	0.795	0.701	0.580	0.428	0.237
0.45	2.64	Min	0.797	0.761	0.723	0.684	0.644	0.604	0.563	0.522	0.481	0.440	0.399	0.357	0.316	0.276	0.235	0.195	0.155	0.116	0.077	0.038
0.50	3.00	Max	0.750	0.787	0.823	0.857	0.889	0.918	0.945	0.967	0.984	0.996	1.000	0.995	0.980	0.951	0.905	0.840	0.750	0.629	0.471	0.265
0.50	3.00	Min	0.750	0.712	0.673	0.634	0.595	0.556	0.516	0.477	0.437	0.399	0.360	0.322	0.284	0.247	0.210	0.174	0.138	0.102	0.068	0.034
0.55	3.44	Max	0.697	0.736	0.773	0.810	0.845	0.879	0.910	0.939	0.963	0.982	0.995	1.000	0.994	0.976	0.941	0.884	0.801	0.683	0.520	0.298
0.55	3.44	Min	0.697	0.659	0.620	0.582	0.543	0.505	0.468	0.430	0.394	0.357	0.322	0.287	0.252	0.219	0.185	0.153	0.121	0.090	0.059	0.029
0.60	4.00	Max	0.640	0.678	0.717	0.755	0.793	0.830	0.866	0.900	0.931	0.958	0.980	0.994	1.000	0.993	0.970	0.926	0.852	0.740	0.575	0.337
0.60	4.00	Min	0.640	0.602	0.564	0.527	0.490	0.454	0.418	0.384	0.350	0.316	0.284	0.252	0.221	0.191	0.162	0.133	0.105	0.078	0.051	0.025
0.65	4.71	Max	0.577	0.615	0.654	0.693	0.732	0.772	0.811	0.849	0.886	0.920	0.951	0.976	0.993	1.000	0.992	0.962	0.902	0.800	0.637	0.385
0.65	4.71	Min	0.577	0.540	0.504	0.469	0.434	0.401	0.368	0.336	0.306	0.276	0.247	0.219	0.191	0.165	0.139	0.114	0.090	0.066	0.044	0.022
0.70	5.67	Max	0.510	0.546	0.584	0.622	0.662	0.702	0.744	0.785	0.826	0.867	0.905	0.941	0.970	0.992	1.000	0.989	0.948	0.863	0.708	0.443
0.70	5.67	Min	0.510	0.475	0.441	0.408	0.377	0.346	0.317	0.289	0.261	0.235	0.210	0.185	0.162	0.139	0.117	0.096	0.075	0.056	0.036	0.018
0.75	7.00	Max	0.437	0.471	0.506	0.543	0.581	0.621	0.663	0.706	0.750	0.795	0.840	0.884	0.926	0.962	0.989	1.000	0.984	0.924	0.787	0.516
0.75	7.00	Min	0.437	0.405	0.375	0.346	0.318	0.291	0.265	0.241	0.217	0.195	0.174	0.153	0.133	0.114	0.096	0.078	0.062	0.045	0.030	0.015
0.80	9.00	Max	0.360	0.390	0.421	0.454	0.490	0.527	0.567	0.609	0.654	0.701	0.750	0.801	0.852	0.902	0.948	0.984	1.000	0.976	0.872	0.609
0.80	9.00	Min	0.360	0.332	0.306	0.281	0.257	0.234	0.213	0.193	0.174	0.155	0.138	0.121	0.105	0.090	0.075	0.062	0.048	0.035	0.023	0.011
0.85	12.33	Max	0.277	0.302	0.328	0.356	0.387	0.420	0.455	0.493	0.535	0.580	0.629	0.683	0.740	0.800	0.863	0.924	0.976	1.000	0.955	0.730
0.85	12.33	Min	0.277	0.255	0.233	0.213	0.195	0.177	0.160	0.145	0.130	0.116	0.102	0.090	0.078	0.066	0.056	0.045	0.035	0.026	0.017	0.008
0.90	19.00	Max	0.190	0.208	0.227	0.248	0.271	0.297	0.324	0.355	0.390	0.428	0.471	0.520	0.575	0.637	0.708	0.787	0.872	0.955	1.000	0.881
0.90	19.00	Min	0.190	0.174	0.158	0.144	0.131	0.119	0.107	0.096	0.086	0.077	0.068	0.059	0.051	0.044	0.036	0.030	0.023	0.017	0.011	0.005
0.95	39.00	Max	0.097	0.107	0.118	0.130	0.143	0.157	0.174	0.192	0.213	0.237	0.265	0.298	0.337	0.385	0.443	0.516	0.609	0.730	0.881	1.000
0.95	39.00	Min	0.097	0.089	0.081	0.073	0.066	0.060	0.054	0.048	0.043	0.038	0.034	0.029	0.025	0.022	0.018	0.015	0.011	0.008	0.005	0.003

Tom, KC6UZZ, Rich UCR Student and Dick, K6HIJ look at the Plasma generator to help Rich fix it. The San Bernardino Microwave Society is a technical amateur radio club affiliated with the ARRL having a membership of over 90 amateurs from Hawaii and Alaska to the east coast and beyond. Dues are $15 per year, which includes a badge and monthly newsletter. Your mail label indicates your call followed by when your dues are due. Dues can be sent to the treasurer as listed under the banner on the front page. If you have material you would like in the newsletter please send it to Bill WA6QYR at 247 Rebel Road Ridgecrest, CA 93555, bburns@ridgecrest.ca.us, or phone 760-375-8566. The newsletter is generated about the 15th of the month and put into the mail at least the week prior to the meeting. This is your newsletter. SBMS Newsletter material can be copied as long as SBMS is identified as source.

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